

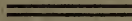
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Vol. 13

JUNE 23, 1917

No. 21

University of Pittsburgh Bulletin



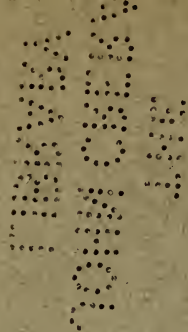
ANNOUNCEMENT SERIES

THE SCHOOL OF MINES

1917-1918

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University of Pittsburgh Bulletin

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CALENDAR

1917—1918

September 24-25.....	Monday-Tuesday—Registration for Freshmen.
September 26-27.....	Wednesday-Thursday—Registration for Sophomores and Juniors.
September 28.....	Friday—Registration for Seniors.
October 1.....	Monday—First Semester begins.
Nov. 29-Dec. 1.....	Thursday to Saturday—Thanksgiving recess.
December 24.....	Monday—Christmas vacation begins.
January 7.....	Monday—Classes resume work.
February 4.....	Monday—Mid-year examinations begin.
February 11.....	Monday—Second Semester begins.
February 22.....	Friday—Washington's Birthday.
February 28.....	Thursday—Charter Day.
March 25.....	Monday—Easter vacation begins.
April 1.....	Monday—Classes resume work.
May 30.....	Thursday—Decoration Day.
June 10.....	Monday—Final examinations begin.
June 16.....	Sunday—Baccalaureate Sermon.
June 19.....	Wednesday—Commencement.
June 17 to 22.....	Monday to Saturday, inclusive—College Entrance Board Examinations for admission.
June 24.....	Monday—Summer Term begins.

OFFICES AND OFFICE HOURS

Office, 102 State Hall, Grant Boulevard—Consultation Hours: 9:00 A. M. to 5:00 P. M.

General Office, State Hall; Telephone Schenley 3300.

For catalogs and other information, address the Secretary of the University, Grant Boulevard.

ADVISORY BOARD

HIS EXCELLENCY, MARTIN G. BRUMBAUGH, Governor of the Commonwealth.

HON. PAUL HOUCK, Secretary of Internal Affairs of the Commonwealth.

HON. NATHAN C. SCHAEFFER, LL.D., Superintendent of Public Instruction.

FACULTY

SAMUEL BLACK MCCORMICK, A.M., D.D., LL.D., CHANCELLOR.

S. B. LINHART, A.M., D.D., Secretary of the University.

*ALBERT ELLIS FROST, A.M., Sc.D., Registrar.

MARSHMAN EDWARD WADSWORTH, PH.D., DEAN EMERITUS; Professor of Mining Geology EMERITUS; Curator of Geological and Mineralogical Collections.

HARRY BERTINE MELLER, E.M., DEAN; Professor of Mining.

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ROSSELL HILL JOHNSON, M.S., Professor of Geology, and of Oil and Gas Production.

ROBERT MOFFITT BLACK, A.B., B.S., E.M., Assistant Professor of Mining.

ANDREW BENNETT WALLGREN, M.D., Lecturer on First Aid to the Injured.

LOUIS G. HUNTLEY, E.M., Lecturer on Foreign Oil Fields.

JOHN EARLE BROWN, B.S., Instructor in Geology and in Oil and Gas Production.

_____, Instructor in Mining.

_____, Assistant in Surveying.

*Deceased; May 11, 1917.

INSTRUCTORS IN OTHER DEPARTMENTS GIVING INSTRUCTION IN SCHOOL OF MINES

ALEXANDER SILVERMAN, M.S., Professor of Analytical Chemistry.
JESSE HAYES WHITE, PH.D., Professor of Psychology.
JOHN THOM HOLDSWORTH, PH.D., Professor of Finance and Economics.
ARNOLD EDWARD ORTMANN, PH.D., Professor of Paleontology.
CALVIN NAFTZINGER WENRICH, PH.D., Professor of Physics.
DAVID SHEPARD PRATT, M.S., PH.D., Professor of Inorganic Chemistry.
JOHN FREDERICK LOUIS RASCHEN, PH.D., Professor of German.
WILLIAM OLIVER FARNSWORTH, PH.D., Professor of Romance Languages.
IRA GRAESSLE FLOCKEN, A.M., Professor of Accounting.
HOWARD WOODHEAD, PH.D., Professor of Sociology.
LESLIE HUNTINGTON HARRIS, B.S., Associate Professor of Electrical Engineering.
JOSEPH SIOUSSA LAMBIE, C.E., Assistant Professor of Civil Engineering.
JOHN WEBER, M.E., Assistant Professor of Mechanical Engineering.
CLEMENT LINWOOD PERKINS, B.S., Assistant Professor of Organic Chemistry.
GEORGE WILKINSON CASE, C.E., Assistant Professor of Sanitary Engineering.
HARRY ESSEX, PH.D., Assistant Professor of Analytical Chemistry.
MARKS NEIDLE, PH.D., Assistant Professor of Analytical and Physical Chemistry.
EDWARD HOWARD DYCHE, M.E., Assistant Professor of Electrical Engineering.
FRANCIS DOUGHTEN TYSON, PH.D., Assistant Professor of Sociology.
ALBERT BAYARD WRIGHT, A.M., Assistant Professor of Political Science.
WHITFORD HUSTON SHELTON, A.M., Instructor in Romance Languages.
WILL EBERT VAWTER, B.S., Instructor in Inorganic Chemistry.
W. PAUL WEBBER, PH.D., Instructor in Mathematics.
IRVIN WESLEY HUMPHREY, M.S., Instructor in Inorganic Chemistry.
LEROY ALBERT ARTHUR, A.B., Instructor in German.
LAUREN HEWITT ASHE, B.S., Instructor in Inorganic Chemistry.
JOHN FREDERICK KLEIN, A.M., Instructor in German.
LATHROP MILNER ROBERTS, B.S., Instructor in Inorganic Chemistry.
FRANK DOWNING SHUMAKER, B.S., Instructor in Inorganic Chemistry.
WILLIAM ROY WIGLEY, M.E., Instructor in Mechanical Engineering.
PAUL D. CONVERSE, A.M., Instructor in Commerce.
MONTFORT JONES, A.M., Instructor in Finance.
EDWARD BERRY BURGUM, A.B., Instructor in English.
CHARLES SHIVELY MILLER, Director of Physical Education.
HARRY HOLTON PROVIN, Instructor in Physical Education.

LOCATION

STATE HALL, the SCHOOL OF MINES BUILDING, is located at the corner of Grant Boulevard, O'Hara Street and Parkman Boulevard, opposite the Soldiers Memorial, near the Carnegie Institute, including Museum and Library. It is readily accessible from all parts of the City.

SPECIAL ADVANTAGES

The location of Pittsburgh, in the very heart of the bituminous coal fields of the Appalachian system, and in the most richly productive oil fields of Western Pennsylvania, with the great concentration here of mining and metallurgical interests, makes this undoubtedly one of the most advantageous points in the United States in which to study mining and metallurgy.

It is also conveniently located with reference to the bituminous coal fields of Ohio and West Virginia, the anthracite fields of Eastern Pennsylvania, and the Lake Superior iron and copper regions.

EQUIPMENT

1. THE MINERALOGICAL AND GEOLOGICAL LABORATORIES are located in the School of Mines. Their equipment is exceptionally complete, the laboratories ranking among the best in the country. Included are:

THE SMITH CABINET. This collection was formed by the two sisters whose name it bears, and is rich in mineralogical and zoological specimens. Especially is it noteworthy for the size and beauty of the objects from the mineral kingdom.

MINERALOGICAL COLLECTIONS. In addition to the Smith collection there is a systematic, labelled collection of 3,500 specimens, numerous smaller sets illustrative of physical properties, crystallization, etc., and large amounts of exceptionally rich material for student use and identification. For crystallography there are large collections of small wooden models, and larger wooden, glass and pasteboard models for lecture use, as well as the latest instruments for crystal measurement.

PETROGRAPHICAL LABORATORY. This contains about 10,000 rock specimens and 5,000 thin sections for microscopic study, 10 petrographic microscopes and a number of the instruments used in more advanced optical mineralogy.

THE GEOLOGICAL LABORATORIES are equipped with numerous collections illustrative of geological phenomena, geologic maps and government reports, collections of fossils, models illustrating structural geology, etc.,

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courtesy of the Director and Trustees of the Carnegie Museum. Of the staff, opportunity is afforded for the study of biological collections of the Carnegie Museum.

PHYSICS LABORATORY. The collection of material illustration is proceeding rapidly and includes suites of ores from prominent mining districts, and suites of specimens of non-metallic minerals, such as coals, building stones

PHYSICS-INSTRUMENT EQUIPMENT includes a large assortment of instruments used in land surveying, construction work, leveling, geodetic surveying and The instruction of the student in the care, adjustment of various types of instruments has been kept clearly in mind for in the selection of equipment.

MINE LABORATORY is equipped with models illustrating the processes of mining, hoisting, haulage, etc.; hand drills; breast pumps; coal-mining machines; miners' lamps (including electric lamps); apparatus for testing safety lamps; working model of mine fan; instruments for measuring the velocity of air currents, etc.

Steam, air and electricity are directly available as power, there being in the laboratory steam piping, an air compressor and receiver, and a switchboard and complete wiring.

4. **THE OIL AND GAS LABORATORY** is equipped with apparatus for experimental work in connection with the course in Petroleum Engineering, as well as for original research.

5. **GENERAL METALLURGICAL LABORATORY.** This laboratory is at present equipped chiefly for metallurgical analysis and electrolytic experiments in metal plating, refining, etc. Calorimetry work is also carried on and the preparation of metal samples for microscopic examination.

For metallurgical analysis there are the usual glass and porcelain ware, hot plates, balances, etc. There are two large laboratory tables for student use, with individual lockers, and a good hood on each table. For electrolytic work we have ten lead cells and five Edison cells, so connected as to give several different voltages; also a potentiometer, volt and ampere meters, and rheostats for measuring current and energy used and regulating the same. The equipment for calorimetry includes one each: Emerson, Parr and Junker calorimeters for solid, liquid and gas fuels; and for gas analysis an Orsatt apparatus and a Morehead burner.

6. **METALLOGRAPHY LABORATORY AND DARK ROOM.** The equipment for metallography includes one Leitz Micro-metallograph, and two ex-

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while through the courtesy of the Director and Trustees of the Carnegie Museum, with part of the staff, opportunity is afforded for the study of the excellent paleontological collections of the Carnegie Museum.

ECONOMIC GEOLOGY LABORATORY. The collection of material illustrative of Economic Geology is proceeding rapidly and includes suites of ores from most of the prominent mining districts, and suites of specimens of the more important non-metallic minerals, such as coals, building stones and clays.

2. **THE FIELD-INSTRUMENT EQUIPMENT** includes a large assortment of the various types and makes of instruments used in land surveying, railroad surveying, construction work, leveling, geodetic surveying and mine surveying. The instruction of the student in the care, adjustment and use of the various types of instruments has been kept clearly in mind and well provided for in the selection of equipment.

3. **THE MINING LABORATORY** is equipped with models illustrating the principal systems of mining, hoisting, haulage, etc.; hand drills; breast drills; rock drills; coal-mining machines; miners' lamps (including electric lamps); apparatus for testing safety lamps; working model of mine fan; instruments for measuring the velocity of air currents, etc.

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6. **METALLOGRAPHY LABORATORY AND DARK ROOM.** The equipment for metallography includes one Leitz Micro-metallograph, and two ex-

cellent metallurgical microscopes with cameras. Suitable grinding and polishing machinery is located in the general laboratory near by. Adjoining the laboratory is a commodious, well-ventilated dark room equipped with photographic finishing necessities, and also copying camera.

7. **HEAT TREATMENT.** The furnace laboratory is well supplied with furnaces, gas, coal, and electric, for a large variety of experiments in heat treatment, annealing, hardening, forging, etc., of metals.

The pyrometric equipment for this work has now been brought up to a very good basis. It includes a Brown recording millivoltmeter, a Leeds and Northrup potentiometer, several millivoltmeters of high grade for both rare metal couples and base metal couples, a Mesure & Nouel pyrometer, and a Fery Radiation pyrometer loaned by the Taylor Instrument Companies. A curve drawing critical point indicator has just been purchased for alloy investigation. There is a Brinell hardness testing machine, and in the Mechanical Engineering Department is an excellent equipment of other physical testing machinery which is available for this work.

FURNACE LABORATORY. The furnace equipment occupies a room some 34 by 70 feet. Five two-muffle Denver Fire Clay Co. assay furnaces are built into one block, in addition to which two American Gas Furnace Co. muffle furnaces of good size, and several other smaller gas fired furnaces. There is a Rockwell gas fired crucible furnace which will hold a No. 40 crucible, and several smaller crucible furnaces suitable for melting small lots of copper or other metals.

Two sintering pans have been placed in this laboratory, of a size large enough for small scale testing. The laboratory is well provided with the smaller accessories, such as assay molds, tongs, pyrometers, gages, etc. Individual lockers are provided for students for special equipment.

The electric furnace equipment occupies one section of the general furnace laboratory. For this work some 150 amperes of direct current at 220 volts is available from the University power plant; and we have 50 k. v. a. of alternating current at 110 volts. This can be regulated by a special transformer so that some 500 to 600 amperes is available at any voltage from 5 to 110, and somewhat less current at voltages up to 220. Of fixed electric furnaces there are available one Wile shaft furnace, with shaft some 12" diameter, and a tilting, basic lined furnace suitable for metal melting and refining on a small scale. Most of the electric furnace work is done in temporary furnaces built up for the individual experiment.

8. **THE ORE DRESSING LABORATORY.** This laboratory is designed to illustrate the principles of crushing, screening, classification and concentration of ores, and of allied metallurgical processes, such as amalgama-

tion, cyanidation and leaching. It is the opinion here that these principles can be taught as well by laboratory size apparatus as by the larger apparatus, with a great saving of outlay for original equipment and ores.

The crushing and grinding machinery consists of a 6"x10" Blake crusher, a No. 1 Gyratory crusher, a 4"x6" Dodge crusher, a Case laboratory crusher, three sets of Sturtevant laboratory rolls, Iler disk grinder, Abbe pebble mill and McKenna sample grinder.

Sizing and classification apparatus consists of a Sturtevant laboratory shaking screen, a Munroe classifier, and a Richard's pulsator classifier.

Concentration machinery consists of a Richard's pulsator jig, a Vezin laboratory jig, a laboratory size Wilfley table, a Munroe slime table, and a testing unit Hyde flotation machine, M. S. flotation unit.

Cyanidation and leaching are carried on in a leaching plant capable of handling several hundred pounds.

A Hendryx combined agitator and filter tank for either mechanical or air agitation is provided, as well as a vacuum filter and filter press. A bottle shaking apparatus is provided for bottle tests. Accessory apparatus such as buckboards, screens, sampling riffles and shovels, feeders, etc., are provided.

9. THE CHEMICAL LABORATORIES. These, with the lecture room, occupy the entire third floor of the Engineering Building. Both lecture room and laboratories have been equipped throughout in the most modern manner. Separate laboratories have been installed in the following branches: Introductory Chemistry and Qualitative Analysis; Quantitative Analysis and Food Analysis, with Balance Room in connection; Gas and Fuel Analysis; Water Analysis; Organic Chemistry; Physical and Electro-Chemistry; Spectroscopy; Photography; Micro-Chemistry and Research. On the fourth floor there is a special room for preparation and storage of distilled water, which is delivered by gravity to the various laboratories where it is on tap. A spacious store-room permits the distribution of supplies in such a manner that the requirements of students are promptly met. Machinery for suction and air pressure has been installed and a first-class ventilating system provided so that the air in the laboratories may be pure at all times. The department library is well supplied with works of reference on chemistry for students' use.

10. PHYSICAL LABORATORIES. These are on the first and second floors of the Engineering Building. The lecture room and a large apparatus-room adjoining are on the first floor. The lecture room has a seating capacity of 150, and is provided with all the appliances to facilitate a complete course of experimental lectures.

The general physical laboratory on the second floor is very fully equipped with new apparatus, and is complete in its appointments in every

respect. Smaller laboratories are provided for photometry, advanced laboratory practice and research.

A well-equipped shop and mechanician provide excellent facilities for making and repairing apparatus.

The equipment of the department is new and includes an excellent collection of instruments for accurate measurement and investigation.

11. STEAM LABORATORY. There is provided the usual equipment for measuring the pressure, temperature and flow of steam, such as gauges, thermometers, calorimeters, condensers, and indicators, together with suitable apparatus for standardizing and calibrating these.

12. ENGINE AND POWER LABORATORY. The equipment for this department includes the following:

A Babcock & Wilcox, 100 H. P., 200-pound pressure boiler, with a superheating chamber, to be used in experimental and power-plant work.

A complete cross-compound steam engine, $7\frac{1}{2}$ inches and 18 inches by 14 inches, provided with friction-brake, which serves for applying loads. Either side may be operated as a simple engine, condensing or non-condensing.

A two-cylinder Westinghouse gas-engine, and two three-cylinder Westinghouse gas-engines for power purposes.

A motor-driven air-compressor, furnishing air for laboratory needs, and arranged to be used for experimental purposes.

13. MATERIALS TESTING LABORATORY. Equipped with machines and instruments for the measurement of the physical properties of the materials of construction, and for tests on manufactured specimens.

Three Universal testing machines, for tension, compression and flexure tests. The largest, a machine of 200,000 pounds capacity, is capable of taking 15-foot columns, tension specimens accordingly, and flexure specimens up to 20-foot lengths.

Torsion machine, a hand-power machine of 5,000 pounds capacity.

Cement-testing apparatus, including two automatic briquette-testing machines, standard molds, scales, sieves, moist closet, etc., for the examination of cements, cement-mortars and concrete.

Structural materials testing apparatus, consisting of experimental shearing and punching attachments for testing machines, special extensometers for structural specimens, and a Hanna pneumatic riveter with a capacity of 100,000 pounds die pressure.

14. HYDRAULIC LABORATORY. For hydraulic experiments there are a Worthington two-stage turbine pump, driven by a variable-speed motor, a Pelton wheel, and receiving and measuring tanks with weir discharge. There are also water-meters, orifices, nozzles, a Venturi meter, etc.

15. ELECTRICAL ENGINEERING LABORATORIES. The machine-laboratory equipment provides for the thorough testing of alternating and direct-

current motors by various brake methods, the determination of characteristic curves of generators, synchronous converters, arc lamps, recording meters, storage batteries, etc. The equipment includes a number of generators, motors, etc.

The department switch-board is located in this laboratory and connections can readily be made as desired in any laboratory with the general source of supply or to any machine in the testing laboratory for special work. Power is supplied to the board, both from the Duquesne Light Company and the University Power-Plant, located in the Mechanical Laboratory.

A Westinghouse storage battery of 60 cells, each of 120 ampere-hours capacity, is installed in a separate room. This storage battery, in addition to being used for testing purposes, is also employed for instrument calibration and photometric work.

The photometric equipment is in a special room, and includes all necessary fittings for the work.

In the standard-measurement laboratory, arrangements have been made for work with the potentiometer, calibration of meters, measurements with standard resistances, capacities and inductances or other similar work.

Tests of electrically-operated mining machinery are made in connection with the course in mining.

A small shop has been equipped and put in charge of a competent mechanician, whose time is devoted to the maintenance of the laboratory equipment and the construction of new equipment for special work. This is of great advantage in connection with thesis work or any line of original investigation which it is desired to carry on as it greatly facilitates the erection of special devices which it would otherwise be difficult to secure. Students are also permitted to use the shop in connection with laboratory tests when desirable.

16. PITTSBURGH EXPERIMENT STATION OF THE UNITED STATES BUREAU OF MINES, for the investigation of mine explosions and other factors relating to mining. Its work is available for the students, who are taught there: First Aid to the Injured, and Mine Rescue Work, receiving certificates therefor from the United States Government, and the United States Red Cross Association.

17. THE LIBRARY. The total number of volumes in the University Library is about 22,000. The Reading Room is at present maintained in connection with the Library, and is well supplied with the leading scientific periodicals.

THE CARNEGIE LIBRARY, with its immense collection of scientific books and periodicals, is near the School of Mines Building, and all of the files and collections are available for the use of students.

REQUIREMENTS FOR ADMISSION

All candidates for admission to the School of Mines must be at least seventeen years of age and furnish testimonials of good moral character. Those who come from other institutions must present certificates of honorable dismissal.

METHODS OF ADMISSION

I. CERTIFICATES of the College Entrance Examination Board and of the New York Regents are accepted in lieu of entrance examinations at the University.

For information concerning the dates upon which the examinations of the College Entrance Examination Board are to be held, address The Registrar of the University of Pittsburgh.

II. CERTIFICATES FROM ACCREDITED SCHOOLS. Instead of examination, certificates from high schools and academies whose work has been approved by the University as being equivalent to that required for admission to the Freshman class, will be accepted. The official blank provided by the University should be used. It may be obtained upon application to the Registrar or Dean.

III. FROM OTHER COLLEGES. Students from other institutions having entrance requirements equivalent to those of the University of Pittsburgh and offering equivalent courses of study, will be given provisional credit for the work done and admitted to advanced standing without examination. If their work proves satisfactory, the provisional credits will be made permanent.

IV. SPECIAL STUDENTS. Students showing satisfactory evidence of ability, but who are not candidates for a degree, may be admitted without examination to take any work for which they are prepared. This includes students taking irregular or partial courses owing to lack of time to follow the regular course, as well as persons of age and experience in practical work who wish to take special courses.

EXPLANATION OF REQUIREMENTS FOR ADMISSION

The University sets no time at which it will offer regular scheduled examinations for admission. This may be arranged if occasion arises. The practical agreement of High School courses in general with the list

of subjects allowed for entrance makes such examinations for the most part unnecessary.

For admission to the School of Mines the student who is a candidate for a degree must offer fifteen units, a unit being the equivalent of four recitations per week of one hour each for one year, or five recitations of three-quarters of an hour each.

The units are as follows for 1917:

English, 3 units.

Algebra, $1\frac{1}{2}$ units.

Plane and Solid Geometry, $1\frac{1}{2}$ units.

History, 1 unit.

Language, other than English, 2 units.

Physics, 1 unit.

Five additional units must be offered from the approved list, which includes Latin, Greek, Modern Languages, English, History, Civics, Economics, Mathematics, General Science, Physiography, Drawing, Manual Training, Geology, Astronomy, Commercial Geography, Chemistry and Biology. In general, any subject given regularly in an approved high school and properly certified by the Principal will be accepted.

CONDITIONS

No applicant to the Freshman Class with less than fifteen units will be admitted as a regular student. No condition will be allowed except in specific subjects, in which there may be no more than two units. It is highly desirable that a student should enter without any conditions, but if they are allowed, they must be removed in part before the Sophomore year, and wholly before the Junior year.

REGISTRATION

The office of the Registrar is in Room 109, State Hall. At this office all registration will be directly made.

All officers of instruction are required to follow the same rules, and under no circumstances to admit to a place upon their rolls the name of any student who has not a card, issued or authorized by the Registrar, in testimony of the fact that he has complied with all regulations, general and specific, both as to his admission and classification, and the payment of tuition or fees.

The office of the University Registrar is open throughout the year. Old students are required to renew their registration before the beginning of every semester, both at the opening of the school year and during the progress of the year.

A penalty of three dollars per semester for late registration may be added to the semester bill. Further information with regard to details may be obtained as required at the office of the Registrar.

VACCINATION

The University requires for admission a certificate from a physician, stating that the student has been successfully vaccinated against smallpox or has had smallpox. This must be presented, properly filled out and signed, at the time of registration. In default of this, registration will not be permitted unless the student will submit to inspection or vaccination by the University Department of Health. This requirement is necessary to carry out the laws of the State of Pennsylvania and of the City of Pittsburgh as they refer to vaccination and school attendance. Blank forms of certificate issued by the University will be sent upon application to the Registrar.

ATTENDANCE

Each instructor has charge of absences, conduct and work of the students when in his class. He is required to keep a record of the absences, and to see that work is satisfactorily made up. If these absences are such as seriously to interfere with the progress of the student, the student may be excluded from the examination and required to repeat the work.

SCHOLARSHIPS

A limited number of scholarships are available in the School of Mines. These scholarships entitle the holders to a part or all of the tuition. For a list of these scholarships and information concerning the conditions under which they are awarded, apply to the Secretary of the University.

TUITION AND FEES

(For regular school year—First and Second Semesters.)

Tuition \$150.00, payable in two installments, \$80.00 first semester and \$70.00 second semester.

Summer Course in Surveying, \$45.00, not including board.

This amount includes all laboratory and shop fees, matriculation fee, student activities fee, and an athletic fee which entitles the student to

admission to all University athletic events. There are no other payments to the University except the diploma fee, to be paid on graduation, but each student who takes laboratory courses will be charged for materials which he uses. Registration for each semester must be completed before the day on which the semester opens. A fine of three dollars is charged for registration following that date.

Rooms and board in the immediate vicinity of the University are easily secured. A list of excellent places may be seen at the University. A committee of Y. M. C. A. students is glad to render service to new students in securing a suitable home. The cost of room and board will vary from \$10.00 per month up for room, and for board from \$4.00 per week up.

A Student Employment Bureau will assist in finding places for those desiring to avail themselves of self-help.

DEGREES

The degrees conferred upon those satisfactorily completing courses are, respectively:

Engineer of Mines (E.M.), Metallurgical Engineer (MET.E.), Geological Engineer (GEOL.E.), Petroleum Engineer (PET.E.).

THESIS

A thesis is required of every candidate for degree. The thesis subject, together with an outline of the work proposed, must be approved by the head of the department in which the student is classified, not later than January 15th preceding commencement; and when so approved will be assigned to him on a blank furnished for the purpose. A memorandum of this assignment must be filed in the office of the Dean.

The thesis in the proposed final form must be submitted to the Professor in charge at least two weeks prior to commencement, and must be in the hands of the Dean before Commencement Day.

The results obtained and the thesis prepared in connection with a regularly assigned thesis subject are the property of the University and no part may be published without the consent of the Chancellor.

COURSES IN THE SCHOOL OF MINES

UNDERGRADUATE

In order to retain the advantages of the elective system, whereby the student is permitted to choose his work along the line for which he

seems best fitted, and at the same time to be certain that every man shall have a well-rounded course, the following group system is in effect:

The first two years' work is common to all courses. At the beginning of the third year, the student elects between Mining, Metallurgy, Ore Dressing, Geology and Oil and Gas Production, with a further choice (in Mining) between general mining and coal-mining, with special attention to either the engineering or the business side, according to the option; and (in Metallurgy) between general metallurgy and the metallurgy of iron and steel.

INSPECTION

The industries in Pittsburgh and those conveniently accessible to the city are especially well adapted to illustration of the subjects covered in the School of Mines. Accordingly, visits of inspection to mines, mills, furnaces, oil wells, etc., are scheduled at frequent intervals. Owners and managers cooperate in every way possible, and the trips add greatly to the efficiency of the instruction. Each trip is under the direct supervision of the instructor, and written reports are required.

SUMMER COURSE IN SURVEYING

During the summer following the freshman year a course in Surveying is given at Camp Hamilton, the University's summer camp, near Windber, Pa. The course includes general land surveying, topographic, geodetic, railroad surveying, mining claim location and official surveys, and underground surveying. All of the field work required in the course is completed during this summer term of ten weeks. The location is ideal for the type of work desired. The students live under canvas. The days are pleasant, and the nights, though cool, are comfortable. The topography in the vicinity of the camp is such that field work is under as severe conditions as are usually found in practice. For the mine surveying, the students are taken into the mines of the Berwind-White Coal Mining Company, upon whose land the camp is located.

COÖPERATIVE WORK

During the summer vacations, following the sophomore and junior years, the student is expected to spend his time in practical work in mine, mill or smelter, or in the field; he is here placed upon the same basis as other employees of the company to which he is assigned, and receives the same pay as others doing the same grade of work. The superintendent advises the Dean periodically as to the progress made, and at the close of the summer period the student makes a written report, which is graded in the same way as is class work. Upon graduation, then, he will have had the advantage of considerable practical work in his chosen field. An important feature of the work of the School of Mines is this

linking of theory with practice and it is all important to the student in his preparation for his profession.

The positions to which students are assigned cover all phases of the work in mining, metallurgy, geology and oil and gas production. In addition to the Pittsburgh district, students are placed in camps in Arizona, Colorado, Idaho, Michigan, Minnesota, Montana, Missouri, Texas, New Mexico, South Dakota, Oklahoma, Ontario, etc.

MILITARY DRILL

Military training is required of all physically fit male students. The course is that prescribed for the Senior Division of the Reserve Officers Training Corps, an outline of which will be found on page 44.

The hour from one to two in the afternoon is left free for military drill five days per week. In addition, two lectures or recitations per week will be required.

GRADUATE

For graduate courses in the School of Mines, see also the bulletin of the Graduate School.

The aim is to offer such advanced work in Economic Geology, Mining, Oil and Gas, Metallurgy and Ore Dressing, as will meet the needs of men having at least one year of practical work following graduation from a recognized mining school.

In addition to the subjects mentioned above, certain courses in Economics, Sociology and Psychology, etc., have been arranged with special reference to their application to mining and metallurgy, with the idea of training men along managerial lines.

Each application for admission will be decided upon its own merits. In general, however, graduation from a recognized technical school, supplemented by at least one year's practical work, will be necessary for admission.

OUTLINE OF COURSES

GROUP I. Leads to degree of Engineer of Mines.

(a) General Mining.

Mechanical-Electrical option.

Management option.

(b) Coal Mining.

Mechanical-Electrical option.

Management option.

GROUP II. Metallurgy. Leads to degrees of Metallurgical Engineer.

(a) General Metallurgy.

(b) Metallurgy of Iron and Steel.

(c) Ore Dressing.

GROUP III. Geology. Leads to degree of Geological Engineer.

GROUP IV. Oil and Gas Production. Leads to degree of Petroleum Engineer.

(a) Geological Option.

(b) Operating Option.

FRESHMAN AND SOPHOMORE YEARS

REQUIRED IN ALL GROUPS

FRESHMAN YEAR

SUBJECT	FIRST SEMESTER			SECOND SEMESTER		
	—Hours—			—Hours—		
	No.	Class	Lab.	No.	Class	Lab.
Mathematics	21	5	....	22	5	....
Chemistry	1	2	6	2	2	6
Graphics	1	1	6	2	1	3
English	3	3	....	4	3	...
German, French or Spanish.....	1	3	....	2	3	....
Physical Education	1	....	3	2	....	3
Mining Surveying .....	....	....	....	2	1	3

Mining Surveying 3—10 weeks following second semester.

SOPHOMORE YEAR

SUBJECT	FIRST SEMESTER			SECOND SEMESTER		
	—Hours—			—Hours—		
	No.	Class	Lab.	No.	Class	Lab.
Mathematics	23	5	....	....	....	...
Mathematics .....	....	....	....	24	4	....
Chemistry	21	2	6	22	2	6
Physics	7	4	3	8	4	3
Mining Geology	1	5	6	2	5	6
Physical Education	3	....	3	4	....	3
Spanish Conf. (Elective).....	....	1	....	....	1	....

Military Training is in addition to the courses noted above.

*Half semester.

DEPARTMENTS OF INSTRUCTION

The following include the required courses in the School of Mines, together with a few electives which it was thought might be chosen by students of the School. For further studies which are open as electives, see the general catalog of the University.

ENGLISH

3, 4.

MR. BURGUM

A course designed particularly for prospective mining engineers, comprising detailed study of the formal mechanics of writing; the rules of sentence, paragraph, and thematic structure, especially as applied to technical exposition and argumentation; oral reports and public speaking; the engineering profession—its dignity, its scope and the requisites for its successful practice.

Texts: Woolley's *Handbook of Composition*, Slater's *Freshman Rhetoric*, Sypher's *Handbook of English for Engineers*, Waddell and Harrington's *Addresses to Engineering Students*.

Three recitations a week, First and Second Semesters, Freshman year.

GERMAN LANGUAGE AND LITERATURE

PROFESSOR RASCHEN, DR. RICHTER, AND MESSRS. ARTHUR, KLEIN AND
FAIRFIELD

1, 2. ELEMENTARY GERMAN

PROFESSOR RASCHEN, AND MESSRS. ARTHUR AND KLEIN

First and Second semesters, Freshman year

A continuous course for students in the essentials of German. The formal study of grammar subordinated to the direct method of acquiring command of the spoken and written idiom. German is the chief medium of instruction. Mastery of phonetic principles. Reading of easy prose works. Reproduction of text in German. Systematic acquisition of vocabulary. Learning of folksongs. Retroversion. Writing German. Inductive study of grammatical forms.

Three recitations per week.

3, 4. INTERMEDIATE GERMAN

DR. RICHTER, AND MESSRS. ARTHUR, KLEIN AND FAIRFIELD

First and Second semesters

Reading of modern narrative and descriptive prose. Reproduction of

text in German. Simple composition. Summarization of principles of grammar.

Three recitations per week.

Prerequisite: Courses 1, 2, or two years of High School German.

T3, T4. TECHNICAL GERMAN

MR. KLEIN

First and Second semesters

Rapid review of grammar. Reading of texts on technical subjects. Reading from German scientific journals. Collateral reading.

Three recitations per week.

Prerequisite: Courses 1, 2, or two years of High School German.

ROMANCE LANGUAGES AND LITERATURE

PROFESSOR FARNSWORTH, DR. BOYCE, AND MR. SHELTON

French

1, 2. ELEMENTARY FRENCH

First and Second semesters, Freshman year

Composition and easy reading, with thorough drill in pronunciation and practice in speaking.

Three recitations per week.

3, 4. INTERMEDIATE FRENCH

First and Second semesters

Fraser and Squair's Grammar completed. Selections from representative authors will be read. Exercises in French conversation.

Three recitations per week.

Spanish

1, 2. ELEMENTARY SPANISH

First and Second semesters, Freshman year

A thorough study is made of the elements of the language, with constant practice in oral work.

Three recitations per week.

C3, C4. COMMERCIAL SPANISH

Reading of commercial and technical Spanish. Business correspondence. Conversation. The vocabulary of everyday life is emphasized.

Three recitations per week.

Italian

1, 2. ELEMENTARY ITALIAN

The instruction is practical and consists of a thorough drill in the elements of the grammar and in pronunciation. Translations, dictation, conversation and easy composition.

Three recitations per week.

3, 4. ITALIAN, INTERMEDIATE COURSE

First and Second semesters

Italian literature of the XVIII and XIX centuries. Selected readings and brief lectures in Italian. Conversation and composition.

Open to students who have taken the course in Elementary Italian.

Three recitations per week.

MATHEMATICS

PROFESSOR WEBBER

21, 22, 23. MATHEMATICS

Five hours per week, both semesters, Freshman year

Five hours per week, First semester, Sophomore year

A combined course in mathematics treating: graphic algebra; trigonometry with applications to surveying and mechanics; analytic geometry; higher algebra; derivatives and integrals with their applications to geometry, analytic geometry, physics and mechanics.

Each of these courses is prerequisite to the succeeding one.

24. ANALYTIC MECHANICS

Four hours per week, Second semester, Sophomore year

The principles of mechanics, founded on Newton's Laws of Motion; applications to the simpler physical problems of particles and bodies in equilibrium and in motion.

Prerequisite: 23.

CHEMISTRY

PROFESSOR SILVERMAN AND ASSISTANTS

1, 2. GENERAL INORGANIC CHEMISTRY

PROFESSOR SILVERMAN AND ASSISTANTS

First and Second semesters, Freshman year

A study of the metals and non-metals, principles, theories and calculations. This course is intended for mining students who have not had chemistry in preparatory schools. Visits are made to a considerable

number of manufacturing establishments so that the student may see practical applications of chemical principles. Two lectures and two three-hour laboratory periods per week. A recitation is conducted at the beginning of each laboratory period. A conference is held weekly, attendance on which is voluntary; the student is thus given an opportunity to present any questions which may arise.

111, 112. ADVANCED INORGANIC CHEMISTRY

PROFESSOR SILVERMAN

First and Second semesters, Senior year, Group II
(General Metallurgy and Iron and Steel options)

This course supplements the work in courses 1 and 2, which are pre-requisite. It deals especially with modern chemical theory.

21, 22. QUALITATIVE AND QUANTITATIVE ANALYSIS

PROFESSOR NEIDLE AND ASSISTANTS

First and Second semesters, Sophomore year

A study of the qualitative tests applied in detection of the more common elements and compounds followed by methods for separation of the various elements from each other. On completion of this work, the student is given instruction and practice in the exact or quantitative determination of some of the above elements by both gravimetric and volumetric methods. Modern ideas in inorganic and physical chemistry are applied. Two lectures and two three-hour laboratory periods per week.

29. GAS ANALYSIS AND CALORIMETRY

PROFESSOR NEIDLE AND MR. BRENNER

First semester, Senior year, Group IV

This course includes the qualitative examination of gases and the more important methods for qualitative analysis of air, natural gas, artificial gases and flue gas. The second period is devoted mainly to the experimental determination of the calorific values of solid, liquid and gaseous fuels, with practice in the use of various fuel calorimeters.

One lecture and two three-hour laboratory periods.

Prerequisites: 21, 22.

31. ORGANIC CHEMISTRY

PROFESSOR PRATT AND ASSISTANTS

First semester, Senior Year, Group IV

An introduction to the chemistry of the compounds of carbon. The student is given an opportunity to prepare a large number of typical carbon compounds and study their properties, reactions, and uses.

Two lectures and two three-hour laboratory periods per week.

Prerequisites: 1, 2, 21, 22.

41, 42. PHYSICAL CHEMISTRY

PROFESSOR NEIDLE

First and Second semesters, Senior Year, Groups III and IV

A study of the laws governing chemical phenomena. The second semester is devoted to a consideration of the theoretical principles and some practical applications of electro-chemistry.

Two lectures and one-three-hour laboratory period.

Prerequisites: 21, 22.

123. ADVANCED QUALITATIVE ANALYSIS

PROFESSOR NEIDLE

First semester

The physico-chemical basis of analytical chemistry is emphasized, and the laboratory work includes qualitative analyses of alloys, ores, paints, etc.

One lecture, one recitation and two three-hour laboratory periods per week.

Prerequisite: 21, 22.

124. ADVANCED QUANTITATIVE ANALYSIS

PROFESSOR NEIDLE

Second semester

The methods introduced in the elementary course are elaborated in complete quantitative analyses of ores, technical products, etc.

One lecture, one recitation and two three-hour laboratory periods per week.

Prerequisite: 21, 22.

First and Second semesters, Freshman year

138. PETROLEUM

Second semester

A two-hour lecture course given in the School of Mines on the chemistry, distillation and refining of petroleum. A laboratory course is also given.

PHYSICS

PROFESSOR WENRICH AND MR. BENEDICT

7, 8. GENERAL PHYSICS

First and Second semesters, Sophomore year

First semester, mechanics, heat and part of electricity. Second semester, electricity, sound and light. Special attention will be given to the practical applications in mining engineering.

Lectures on the precision of measurements will precede the laboratory work. Stress will be laid on the precision of results obtained in the experiments.

One lecture, three recitations and one three-hour laboratory period per week.

GRAPHICS

1, 2. ENGINEERING DRAWING

Use of instruments; graphic solution of geometric problems; orthographic, isometric and perspective projections; problems dealing with points, lines and planes; problems in curved lines and surfaces; machine drawing; freehand sketching; lettering, tracing, blue printing.

One lecture and six hours in drafting room per week, First semester; one lecture and three hours in drafting room per week, Second semester; Freshman year.

MECHANICS

PROFESSOR LAMBIE

3. MECHANICS OF MATERIALS

PROFESSOR LAMBIE

First semester, Junior year

The resistance and elasticity of materials; simple stresses; riveted joints. The action of beams under various conditions of fixity and loading; strength of columns and shafts; combined stresses; resilience of materials, etc.

Four recitations and lectures per week.

5. GRAPHIC STATICS

PROFESSOR LAMBIE

First semester, Junior year, Groups I and II

The solution of problems in which the stresses in frame work, beams, roof and bridge trusses are ascertained by graphical methods. Methods for dead, snow, wind and live loads.

One lecture and six hours' drawing per week.

MECHANICAL ENGINEERING

MR. WIGLEY

M. E. 15. MECHANICAL LABORATORY

Second semester, Junior year, Groups I, II and IV
(Operating option)

The first part of this course will include the testing of materials under tension, compression, torsion, and transverse loads. The second part of the course will take up the testing of boilers, steam engines, turbines, gas engines, and their auxiliaries.

The course is designed to meet the needs of Mining Engineering students.

One lecture and three hours laboratory work per week.

To be taken concurrently with M. E. 16.

M. E. 16. PRIME MOVERS

Second semester, Junior year, Groups I, II and IV
(Operating option)

A brief study of the thermodynamics of heat engines and the construction and operation of boilers, steam engines, turbines, gas engines, and producers.

The course is designed to meet the needs of Mining Engineering students.

Two lectures and recitations per week.

To be taken concurrently with M. E. 12.

ELECTRICAL ENGINEERING

PROFESSOR DYCHE AND MR. GLASS

11. ELECTRICITY APPLIED TO MINING

PROFESSOR DYCHE AND MR. GLASS

First semester, Senior year, Group I
(Mechanical-Electrical option)

First semester, Junior year, Group II

This course is planned with special reference to the needs of Mining Engineering students.

Prerequisite: Physics 7 and 8.

Three lectures and recitations and three hours laboratory per week.

12. ELECTRICITY APPLIED TO MINING

PROFESSOR DYCHE AND MR. GLASS

Second semester, Senior year, Group I
(Mechanical-Electrical option)

Second semester, Junior year, Group II

A continuation of E. E. 11, but more specifically concerned with modern practice in the applications of electricity to the mining industry.

Prerequisite: E. E. 11.

Three lectures and recitations and three hours laboratory per week.

SANITARY ENGINEERING

PROFESSOR McCANDLISS

2. HYDRAULIC LABORATORY

Second semester, Junior year

The experimental study of the flow of water through pipes, nozzles,

orifices, over weirs and in streams. Capacity and efficiency tests of hydraulic turbine pumps and motors.

Three laboratory hours per week.

Taken concurrently with S. E. 6.

6. HYDRAULICS

Second semester, Junior year

The equilibrium and pressure of liquids; the motion and work of fluids; the flow of water through orifices, over weirs, in pipes, and in canals; and hydraulic machinery.

Prerequisite: Mathematics 24.

Four recitations or lectures per week.

ECONOMICS

PROFESSORS HOLDSWORTH, FLOCKEN, WRIGHT AND TYSON,

MESSRS. JONES AND CONVERSE

1. ECONOMICS

MR. JONES

First semester, Junior year, Groups I, II and IV

A brief resume of fundamental economic theory; application to practical economic questions; wages, interest, rent, management, credit, banking, taxation, trusts, tariff, trade, social reform. Text-book and lectures.

Two lectures or recitations per week.

13. MODERN INDUSTRIES

MR. CONVERSE

First semester, Senior year, Group I (Management option) and
Group IV (Operating option)

A study of the leading manufacturing industries including sources, supply and marketing of minerals and other raw materials; factors affecting the location of industry and cost of production; domestic and foreign trade.

Two lectures or recitations per week, with assigned readings and reports.

16. INDUSTRIAL MANAGEMENT

MR. CONVERSE

Second semester, Senior year, Group I (Management option)
Group IV (Operating option)

Advantages of different types of business organizations; principles of business management; factory and plant efficiency; profit-sharing; labor problems; efficiency standards and methods.

Two lectures or recitations per week, with assigned readings and reports.

19. LABOR PROBLEMS

DR. TYSON

First semester, Senior year, Group I (Management option)

Group II (General Metallurgy option)

Evolution of the labor problem; organization and methods of trade unions and employers' associations; open versus closed shop; strikes and lockouts; wage systems; "safety first;" immigration; employers' liability; arbitration and conciliation.

Two lectures or recitations per week, with assigned readings and reports.

21, 24. CORPORATION FINANCE AND INVESTMENTS

MR. JONES

First and Second semesters, Senior year, Group I

(Management option) and Group IV

Legal and financial organization of corporations; classes and characteristics of stocks and bonds; sources of capital; the promoter and underwriting; disposition of earnings; legal and commission control; receiverships and reorganizations; analysis of typical investments.

Two lectures or recitations per week, with assigned readings and reports.

1, 2. ELEMENTARY ACCOUNTING

PROFESSOR FLOCKEN

Both semesters, 3 credits each

A course covering the fundamental elements of accounting, including the principles and practice involved in the derivation of the income statement and balance sheet; the construction, use, and interpretation of these statements; a study of the various books used in accounting; opening and closing entries, and the special accountancy requirements of the sole proprietorship, partnership, and corporate forms of business organization. The elements of cost accounting are considered during the latter part of the course.

12 Ac. MINE ACCOUNTING

PROFESSOR FLOCKEN

Second semester

The principles of general accounting and their application to the recording, classifying and summarizing of mining transactions; the application of cost accounting principles to mining labor, supplies, and overhead, revenue and financial statements; accounting for subsidiary enterprises connected with mining companies.

Two hours per week.

40. STATISTICS

PROFESSOR FLOCKEN

Second semester, Senior year, Groups III and IV

This course is intended to present the methods of determining, ana-

lyzing, and interpreting social and economic facts by the use of statistics. It includes a consideration of the following: sources of statistics; collection of data; analysis and interpretation of data by the use of averages, diagrams, tables and frequency curves; accuracy; variation and correlation; development of statistics; and a consideration of the value of various statistical undertakings. The method is illustrated by its application to reliable data in the field of business and in the social sciences.

Text-books, lectures, and assigned readings.

Two hours per week.

SOCIOLOGY

PROFESSORS WOODHEAD AND TYSON

1, 2. INTRODUCTORY SOCIOLOGY

First and Second semesters

An introduction to the science of society. The content and methods of sociology; the nature of society. Discussion of the physical and mental aspects of group life. A review of the development of social control in industry, the family, the school, and the state. An application of principles to modern social problems.

Two recitations per week.

GEOLOGY

PROFESSOR JOHNSON AND MR. BROWN

101, 102. GEOLOGICAL METHODS

First and Second semesters, Junior Year, Groups III and IV

A training course for men who intend to do field work in geology. General scientific method. Specific geological methods. History of geology from standpoint of method. Study of carboniferous and cretaceous geology from standpoint of method. For graduates and undergraduates.

Two lectures or recitations and one laboratory period per week.

103, 104. GEOLOGICAL LABORATORY

Work upon a series of problems adapted to the needs of the particular student, or research in one problem. For graduates and undergraduates.

Two laboratory periods per week, First and Second semesters.

Two laboratory periods per week, Second semester, Senior year, Group III.

MINING GEOLOGY

PROFESSOR LEIGHTON AND MR. BROWN

1, 2. INTRODUCTORY GEOLOGY AND MINERALOGY

First and Second semesters, Sophomore year

This course is the equivalent of the courses in Introductory Geology and Mineralogy given separately in former years. In it are taken up the origin and classification of minerals and rocks, and the topics of Dynamic, Structural and Historical Geology.

Five lectures and two laboratory periods per week.

3, 4. ECONOMIC GEOLOGY

First and Second semesters, Junior year, Groups I and III

Designed to give the student a general idea of the origin, mode of occurrence, distribution and uses of the non-metallic and metallic mineral resources with special reference to the deposits of North America.

5, 6. PETROGRAPHY

First and Second semesters, Junior year, Group III

A study of optical crystallography, the optical determination of minerals, and the determination and classification of rocks by microscopic methods.

One lecture and two laboratory periods per week.

7. THE GEOLOGY OF COAL

First semester, Senior year, Group III

A study of the United States coal fields from a geologic standpoint. Brief reference is made to the important foreign fields.

Two lectures per week.

8. THE GEOLOGY OF ORE DEPOSITS

Second semester, Senior year, Group III

An advanced study of the origin and mode of occurrence of ore deposits.

Two lectures per week.

9, 10. SEMINAR

First and Second semesters, Senior year, Group III

Current periodicals and new publications dealing with Economic Geology are informally discussed.

One hour per week.

11, 12. ENGINEERING GEOLOGY

Winter term

A course designed primarily for Civil Engineers, covering briefly the subjects of general geology, mineralogy and economic geology. The points of special value to the engineer are emphasized.

Four lectures and one laboratory period per week.

101, 102. ADVANCED MINERALOGY

Advanced or research work in crystallography, mineralogy or petrography. Primarily for graduate students, but open to any student properly qualified.

103, 104. ADVANCED ECONOMIC GEOLOGY

Courses planned to suit the individual student.

PALEONTOLOGY

PROFESSOR ORTMANN

1, 2. GENERAL PALEONTOLOGY

This course is intended to present a general survey of the field of Invertebrate Paleontology. The work will consist of lectures and laboratory work, for which latter the rich resources of the Carnegie Museum provide splendid facilities. The ancient life history of the earth will be treated in broad outlines and the structure of the leading groups of fossil organisms elucidated with a view toward illustrating their lines of development. A first hand acquaintance will be gained with the more familiar types, and the foundation laid for taking up a more detailed study of the different groups of invertebrate animals. Woods "*Elementary Paleontology*" will be used as a text-book, and the English edition of Zittel as a work of reference.

Two recitations and one three-hour laboratory period per week, First semester.

One laboratory period per week, Second semester, Senior Year, Group III and Group IV (Geological option).

MINING SURVEYING

PROFESSOR BLACK

2. TOPOGRAPHICAL DRAWING

Second semester, Freshman year

Plotting with protractor, plotting by coördinates, computation of traverses and areas from field notes, topographical symbols, contours, topographic maps, mechanical and free hand lettering. The course is intended to give preparation for the mapping required in Mining Surveying 3.

One lecture and three hours per week in drafting room.

3. SURVEYING—GENERAL COURSE

Summer following Freshman year

The course includes:

I. PRELIMINARY SURVEYING. Pacing, ranging; preliminary location of mining claim and filing of notice of location; adjustment of Locke level; topographical survey of mining claim by pacing and hand level.

II. LAND SURVEYING. Adjustment of compass; subdivision of land; farm survey; city survey; adjustment of solar attachments; official survey of mining claim.

III. TOPOGRAPHICAL SURVEYING. Adjustment of transit; repetition traverse; azimuth traverse; adjustment of plane table instrument; topographical survey with plane table; topographical survey with transit and stadia; tying in of topographical survey to triangulation system.

IV. GEODETIC SURVEYING. Measurements of base line; triangulation, including computations and adjustment of quadrilateral; adjustment of engineer's level; determination of elevation of bench marks and triangulation points by levelling; observation on Polaris with transit for determination of true azimuth.

V. RAILROAD SURVEYING. Reconnaissance with clinometer and pocket compass; preliminary survey with transit, chain and engineer's level; topography by pacing and hand level; permanent location with transit, steel tape and engineer's level; computation of simple and compound curves; setting curve and line stakes with transit and steel tape; profile levelling; plotting on profile sheet and establishment of grade; cross-sectioning; computation of cuts and fills; computing and laying in turnouts, frogs, switches and Y-junction curves.

VI. UNDERGROUND SURVEYING. Underground practice in surveying; carrying the meridian underground by various methods, such as 2-wire, 3-wire, 4-wire, and with auxiliary telescope; survey of secondary openings, recording of survey, use of mine maps, etc.

Maps are required to be made of the mining claim pacing survey, the mining claim official survey, the azimuth and repetition traverses, the farm survey, the city survey, the stadia survey, and the railroad survey.

The class is divided into squads, each man being required to do every kind of work with every instrument used, make a full set of notes of the work done by his squad, and from those notes make the maps in the drafting room.

This course is given at Camp Hamilton, the University's summer camp, near Windber, Pa., where there is every facility for thorough instruction. The underground work is carried on at mines of the Berwind-White Coal Mining Company near Camp Hamilton.

Fifty hours per week.

4. UNDERGROUND SURVEYING

Underground practice in surveying; carrying the meridian underground by various methods, such as 2-wire, 3-wire, 4-wire, and with auxiliary telescope; survey of secondary openings, recording of survey, use of mine maps, etc.

Two lectures or recitations per week for one semester, in addition to a week or ten days in practical underground surveying.

This course is designed for men who enter with advanced standing and receive credit in Mining Surveying 3, except Part VI.

5, 6. MINE MAPPING

First and Second semesters, Junior year, Group I

Making of maps from survey notes; plan, longitudinal and cross-sections of ore mine; plans of anthracite and bituminous coal mines. For the last, the notes made in Mining Surveying 3 are used.

Three hours per week in the drafting room.

MINING

DEAN MELLER, PROFESSOR BLACK, AND DR. WALLGREN

The aim of the curriculum in Mining Engineering is to impart such knowledge as will enable the student to carry through a mining enterprise successfully. In order to conduct mining operations intelligently, he will be called upon as an engineer to employ the principles of mathematics, physics and mechanics; the sciences of geology, mineralogy, chemistry and metallurgy; and the arts of civil, mechanical and electrical engineering. He must also have ability for organization and business management.

The principles, sciences and arts mentioned are taught by specialists in the different departments, their particular application to mining being specially emphasized.

The student is offered lines of election as follows:

The Mining of Ore (Mechanical-Electrical or Management Option).

The Mining of Coal (Mechanical-Electrical or Management Option).

In every case the student receives instruction in the fundamental principles of mining. In case he elects the mechanical-electrical option in either ore mining or coal mining, he is required to take courses during the Senior year in the application of steam, air and electricity to mining. In the event that he elects the management option, a large part of his Senior year is spent in the study of problems in the economics of mining, such as confront the mine manager, operator and financial agent.

In connection with the department is a laboratory equipped with the most modern machinery used in underground work, steam, air and electricity being directly available as power.

Class instruction is supplemented, where possible, by visits to mines in the vicinity; by reference to mine maps, models, drawings and descriptions of plants, etc.

1. PRINCIPLES OF MINING

PROFESSOR BLACK

First and Second semesters, Senior year, Groups II and III

A shorter course for those not specializing in Mining.

Includes :

Prospecting—Aids, methods, outfits, etc.

Boring—Purposes; percussive boring, rotary boring; survey of bore holes.

Placer Mining—Prospecting and developing; sluicing, hydraulicking, dredging.

Rock Drills—Hand drills; power drills—steam, air and electric.

Explosives—Types, care and use.

Method of Entry—Adit, drift, slope, shaft.

Shaft Sinking and Tunnelling.

Support of Excavations—Pillars of ore or coal, broken ore, timber, masonry, brickwork, metal.

Methods of Mining—Ore; coal; stone; etc.

Coal Mining Machinery—Pick machines; chain cutters; etc.

Mine Gases and Ventilation.

Lighting—Candles; torches; lamps—oil, acetylene, electric.

Haulage—Railways; aerial tramways; etc.

Hoisting—Hoists: steam, air and electric; drums; ropes; skips; cages; etc. Balanced hoisting.

Drainage—Surface and mine. Mine pumps; water hoisting.

Surface Plant—Shaft house; tippie; power house; magazine; store-houses; lamp-house; arrangements for surface transportation; etc. General arrangements for different types of mines.

Accidents—Explosions; fires; falls—their cause and prevention.

Sociology—"Safety First;" mine labor; welfare work; etc.

Visits of inspection are made to working mines in order that the students may become familiar with the practical application of the principles discussed in the class-room.

Three recitations per week.

3, 4, 5. PRACTICE OF MINING—GENERAL

DEAN MELLER

These courses cover the same outline as Course 1, but each of the subjects is treated in more detail, and from the standpoint of the engineer directly interested in mining operations. They are intended for the prospective mining engineer, who desires a comprehensive treatment of all branches of mining. Methods of mining iron, copper, gold, silver, lead, zinc and other ores are studied in detail. Numerous mathematical and other problems, similar to those met in actual engineering practice are introduced, in order to apply the principles covered in the several courses. Special emphasis is laid on the most recent practice, for which reference is made to current periodicals. Working mines in Pennsylvania and adjacent states are used for the purpose of illustration throughout the courses.

Three lectures or recitations per week, First semester; five lectures or recitations per week, Second semester; Junior year.

Five lectures or recitations, First semester, Senior year.

7, 8, 9. PRACTICE OF MINING—COAL

PROFESSOR BLACK

These courses are similar in plan and scope to those described under Practice of Mining—General, but devote most of the time to coal mining methods and the direct application of the several subjects in the outline to coal mining. Mine Gases, Ventilation, Lighting and Mining Machinery are treated in detail, thus meeting the special needs of students having a definite preference for coal mining.

Three lectures or recitations per week, First semester; five lectures or recitations per week, Second semester, Junior year.

Five lectures or recitations, First semester, Senior year.

11, 12. MINING MACHINERY—STEAM AND AIR

PROFESSOR BLACK

First and Second semesters, Senior year, Group I
(Mechanical-Electrical option)

This course covers mining machinery operated by steam or compressed air power. Such equipment for haulage, hoisting, drainage, ventilation, rock drilling, coal cutting and exploration is studied in detail and operated. Various tests are made, including that for efficiency. Mine power plant is considered. Mines are visited at intervals during the course in order to study machinery under working conditions.

Two lectures or recitations and one three-hour laboratory period per week.

ELECTRICITY APPLIED TO MINING. See E. E. 11, 12.

14. MINE PLANT DESIGN

DEAN MELLER AND PROFESSOR BLACK

Second semester, Senior year, Group I

Design of surface structures, such as head-frame, ore-bins, tippie, boiler-house, etc. Preparation of bills of material, cost estimates, contracts and specifications.

Six hours in the drafting room per week.

16. MINE COSTS, MANAGEMENT, AND VALUATION

DEAN MELLER

Second semester, Senior year, Group I
(Management option)

This course covers: Considerations which should precede the opening of mines, as topography, labor conditions, climate, transportation fa-

cilities, etc.; incorporation and capitalization; promotion of mining and exploration companies; investments in mines and mining stocks; reasons for failures in mining; mine administration; details of costs for operation, maintenance, depreciation and amortization, etc. Following this is a study of mining costs of representative companies in the various mining fields of the world.

The course concludes with a study of the factors which assist the engineer in determining the value of a producing mine or a prospect; conduct of the examination; report, etc.

Five lectures or recitations per week.

17. MINING LAW

DEAN MELLER AND PROFESSOR BLACK

First semester, Senior year, Groups I and III

A study of the Revised Statutes and subsequent Acts of Congress governing mining in the United States; State mining laws with especial reference to those of Pennsylvania.

Two lectures or recitations per week.

18. FIRST AID AND MINE RESCUE WORK

PROFESSOR BLACK AND DR. WALLGREN

Half of Second semester, Senior year, Groups I and IV

This course includes instruction in the following subjects: Bruises, sprains, fractures, shock, burns, and gas poisoning, etc.; principles, design and use of the helmet and mouth-breathing devices, resuscitation apparatus, and in the methods of mine rescue work.

19, 20. MINING LABORATORY

PROFESSOR BLACK

121, 122. ADVANCED MINING

DEAN MELLER AND PROFESSOR BLACK

Intended to afford advanced and graduate students an opportunity to continue the study of mining for a post-graduate degree.

Arranged to suit the needs of the individual student.

METALLURGY

PROFESSORS GOODALE AND RAY

1, 2. GENERAL METALLURGY

PROFESSOR RAY

This is a course for those students who are not specializing in metallurgy, and is planned to give a good general knowledge of the metallurgy of the common metals. The course covers, therefore, briefly the methods

of winning the common metals from the minerals in which they occur in nature, and the properties of the metals and alloys and refractory and other materials used in metallurgy. The metals chiefly studied are iron, steel, copper, lead, gold and silver; and less completely zinc, tin, nickel, etc. The laboratory work of the first semester is largely taken up with fire assaying methods for gold, silver and lead; that of the second semester with various tests of metallurgical processes and products.

Two recitations and two laboratory periods, First semester.

Two recitations, Second semester, and two laboratory periods, half of Second semester, Senior year, Groups I and III.

3, 4. GENERAL METALLURGICAL PRINCIPLES

PROFESSORS GOODALE AND RAY

First and Second semesters, Junior year, Group II

The introductory course for those students specializing in metallurgy. The course includes a study of the materials used in metallurgical works such as fuels and refractory materials, and also the metals, alloys and other products of those works, and the operations by which they are produced. The laboratory work follows closely the class work and is concerned largely with the measurements by which the above processes are controlled, and with a study of the materials themselves in the laboratory.

Three recitations and two laboratory periods.

5, 6. THE IRON BLAST FURNACE

PROFESSOR GOODALE

First and Second semesters, Senior year, Group II
(Iron and Steel option)

A study of the design, construction and operation of the blast furnace and its accessories. In connection with the following courses it is planned to cover as completely as possible the special metallurgy of iron and steel so important to Pittsburgh.

Two recitations.

7, 8. THE MANUFACTURE AND PROPERTIES OF STEEL

PROFESSOR GOODALE

First and Second semesters, Senior year, Group II
(Iron and Steel option)

The design, construction and operation of the various furnaces, and machinery used in the refining of pig iron and manufacture of steel, wrought iron, etc. A number of visits to neighboring plants may be made in connection with the laboratory work of the course. The laboratory work includes a study of the metals with the microscope and experiments in reduction and refining.

Three recitations and three laboratory periods.

9, 10. METALLURGICAL CALCULATIONS

PROFESSOR GOODALE

First and Second semesters, Junior year, Group II

A study of and practice in the calculations relating to the design of metallurgical apparatus, and the quantities of heat and material required in operations, and the costs involved.

Two recitations.

11, 12. COPPER, LEAD, THE MINOR METALS

PROFESSORS GOODALE AND RAY

First and Second semesters, Senior Year, Group II

(General Metallurgy and Ore Dressing options)

This course is designed to cover as thoroughly as time permits the metallurgy of these metals. It includes a study of the furnaces and other apparatus used, the operations involved, and methods of control, and also the characteristics of the metals themselves. This course, in connection with numbers 3, 4 and 9, 10, cover in a more thorough manner about the ground covered briefly in numbers 1 and 2.

Four recitations and two laboratory periods.

13, 14. ELECTRO-METALLURGY

PROFESSOR GOODALE AND MR. ———

First and Second semesters, Senior year, Group II

(General Metallurgy and Iron and Steel option)

A careful study of electro-thermic and electrolytic methods applied to the recovery of metals from their ores, and the refining of metals. These methods are of rapidly growing application and importance. The electric furnace is being used for many operations where previously fuel-heated furnaces were used, and electrolytic methods are supplanting older methods for refining and even winning metals. This course is designed to cover such operations.

Two recitations two laboratory periods.

16. GOLD AND SILVER

PROFESSOR RAY

Second semester, Senior year, Group II

(General Metallurgy and Ore Dressing options)

This course covers the metallurgy of gold and silver with special reference to the hydrometallurgy or leaching processes, such as cyanidation—the most important—chlorination, etc. The cyanide process is treated in detail on account of its present and growing importance. The refining of bullion by different methods is thoroughly treated.

Two recitations and two laboratory periods.

17, 18. FIRE ASSAYING

PROFESSOR RAY

First and Second semesters

These courses are designed for special and advanced students who desire to study this subject. Fire Assaying is required of all students taking metallurgy. It will be given to all, except those taking Group II, in connection with the laboratory course of Met. 1. Group II will take it as a part of the laboratory in connection with Met. 3.

The course is designed to give the student a thorough theoretical and practical knowledge of the assaying of ores of gold, silver, and platinum metals by fire methods. Commercial laboratory methods, giving speed of manipulation are taught, as well as more refined methods for special accuracy.

Elective course. Two laboratory periods.

101, 102. METALLOGRAPHY

PROFESSOR GOODALE

First and Second semesters

The study of metals and alloys, their structure, properties. The work of this course includes microscopic methods of study, and also chemical and physical testing and investigation of the properties of metals. Much of the work of this course is given in the laboratory work of course number 7, 8.

Elective course. One recitation and two laboratory periods.

121, 122. ADVANCED METALLURGY

PROFESSORS GOODALE AND RAY

It is designed to give advanced students an opportunity to pursue the study of metallurgy for a postgraduate degree. The work is carried on in each case as the occasion seems to require, to give each student the greatest advantage from his work.

Courses to suit the needs of the student.

ORE DRESSING

PROFESSOR RAY

Ore Dressing is the study of the application of physical laws to those mechanical processes and apparatus which have as an object the breaking of ore and the concentration of valuable minerals, whether metallic or non-metallic. It also involves the study of the apparatus used, its design and arrangement in the plant.

1, 2. GENERAL ORE DRESSING

First and Second semesters

Senior year, Groups I, II (Metallurgy option) and III

A general course dealing with the principles and practice of dressing ores and coal, designed for the general and mining student. It includes

the object and principles of ore dressing; stamp milling, followed by amalgamation and concentration; description of the construction and operation of the principal types of crushers, stamps, classifiers, concentrating devices and accessories. Class room work is aided by models, slides and laboratory apparatus.

Two recitations.

3, 4. ORE DRESSING—SHORT COURSE

First and Second semesters, Senior year, Group II
(Iron and Steel option)

This course is designed especially for students specializing along the lines of iron and steel and metallurgy. It treats of the principles in general and studies those machines which are especially used in the concentration of iron ores. Breaking and crushing, log and trough washers, jig and table concentration and magnetic concentration are all studied in detail. No laboratory work is provided, but same may be taken as substitution for laboratory work in iron and steel in special cases after consultation with head of department of Metallurgy.

Two recitations.

5, 6. ADVANCED ORE DRESSING

First and Second semesters

This more advanced course was designed for those students who intend to follow ore dressing or those lines of metallurgy which are closely allied to ore dressing. It deals with the same subjects as Ore 1, 2, but is more detailed, especially in the study of the theory and principles. Part of the time during the first semester will be given to the especial study of gold and silver milling and hydrometallurgical processes. It is intended that this course, which is given in the General Metallurgical and Ore Dressing option, shall supplement courses Met. 11, 12, in the cases of the hydrometallurgy of the different metals. Also it is intended that the laboratory in each case shall allow a variance in the work taken especially in the second semester. This has the object of giving a maximum of laboratory work along any one line in which a student may be interested.

Five recitations and four laboratory periods, First semester.

Five recitation and two laboratory periods, Second semester, Senior year, Group II (Ore Dressing option).

109, 110. ADVANCED WORK IN ORE DRESSING

First and Second semesters

This course was designed in connection with a regular fifth year or for advanced students. It will take up a much more detailed study of the theory and principles, and of certain processes, notably flotation and

slime treatment. Ore dressing machinery and plant design will be given in the Second semester. In the laboratory, in general, opportunity will be given for the student to follow some particular line of investigation.

Five recitations. Laboratory elective, but at least 12 hours must be taken each semester.

OIL AND GAS PRODUCTION

PROFESSOR JOHNSON, MR. HUNTLEY AND MR. BROWN

The courses in oil and gas are planned to equip men to (a) determine the relative chances of success in finding oil and gas by drilling at different points; (b) methods by which wells are most efficiently spaced, drilled and operated; (c) methods by which the business of oil and gas production is transacted. So much of the oil and gas industry is carried on by crude and inefficient methods that a technical training in these lines greatly increases the efficiency of the worker as compared with the usual training by imitation alone. The practice in the summers is an important part of the work. The first summer is used for the course in Surveying. In the second summer the student ordinarily works on an oil lease; in the third he will work as a geologic aid on the Federal or a State Survey, or again on prospective or developed properties.

There are two courses—one leading to specialization in prospecting, the geological option, and the other leading to specialization in operation. The second may be modified further by those specializing in the business aspects of the oil industry.

1. GEOLOGY OF OIL AND GAS

PROFESSOR JOHNSON AND MR. BROWN

First semester, Junior year, Groups III and IV

Origin, accumulation and occurrence of oil and gas. Methods of determining chances of success in locating oil and gas wells.

Four lectures or recitations per week.

2. COMPARATIVE OIL FIELDS

PROFESSOR JOHNSON, MR. HUNTLEY AND MR. BROWN

Second semester, Junior year, Groups III and IV

A comparative study of the oil and gas fields and promising untested regions of the world.

Four lectures or recitations per week.

3. THE BUSINESS OF OIL AND GAS PRODUCTION

PROFESSOR JOHNSON AND MR. BROWN

First semester, Senior year, Group IV

Leasing, organization of companies, methods of coöperation in drill-

ing tests and offsetting, operation on public lands, drilling contracts, etc. History, leading Companies.

Two lectures or recitations per week.

4. THE TECHNOLOGY OF OIL AND GAS PRODUCTION

PROFESSOR JOHNSON AND MR. BROWN

Second semester, Senior year, Group IV

Spacing of wells, drilling, pumping, transportation and storage. Increasing the percentage of recovery. Gasolene from gas. Distribution of gas.

Two lectures or recitations per week.

6. APPRAISAL AND REPORTS OF OIL AND GAS PROPERTIES

PROFESSOR JOHNSON AND MR. BROWN..

Second semester, Senior year, Group IV

Methods by which the value of oil and gas properties is determined. The methods of examination and of making reports upon properties.

Two lectures or recitations per week.

7, 8. OIL AND GAS LABORATORY

PROFESSOR JOHNSON AND MR. BROWN

First and Second semesters

Exercises and investigations with oil field maps, geological maps, statistics, records of companies, etc., in the geology, business and technology of oil and gas. The work is partly individual and original. To accompany 1 and 2.

Six hours laboratory, First semester; twelve hours laboratory, Second semester, Junior year, Group IV (Geological option).

Three hours laboratory, First and Second semesters, Junior year Group IV (Operating option).

119, 120. ADVANCED OIL AND GAS LABORATORY

PROFESSOR JOHNSON AND MR. BROWN

First and Second semesters

A continuation of the work above, in the following year.

Three hours laboratory, Second semester, Senior year, Group IV (Geological option).

Three hours laboratory, First and Second semesters, Senior year, Group IV (Operating option).

10. EXAMINATION OF AN OIL OR GAS PROPERTY

PROFESSOR JOHNSON, MR. HUNTLEY AND MR. BROWN

Second semester, Senior Year, Group IV

The actual examination and preparation of a report of an oil or gas property.

Six hours field and laboratory per week.

13, 14. SEMINAR IN OIL AND GAS

PROFESSOR JOHNSTON, MR. HUNTLEY AND MR. BROWN

First and Second semesters, Junior year, Group IV

A seminar for the study of current development and progress. The current periodicals and reports are reviewed. New data exhibited. The current statistics are plotted graphically by the several students.

Two hours per week.

15, 16. SEMINAR IN OIL AND GAS—CONTINUED

PROFESSOR JOHNSON, MR. HUNTLEY AND MR. BROWN

First and Second semesters, Senior Year, Group IV

Two hours per week.

MILITARY SCIENCE AND TACTICS

COURSE OF TRAINING FOR ENGINEER UNITS OF THE SENIOR DIVISION

1. MILITARY ART

(a) Practical:

Physical drill (Manual of Physical Training—Koehler).

Infantry drill (U. S. Infantry Drill Regulations), to include the School of the Soldier, Squad and Company, close and extended order.

Practical military engineering — laying out and constructing trenches, obstacles and revetments, Part V, Engineer Field Manual, and 584-595, Infantry Drill Regulations). Use sand table when outdoor work is impracticable.

(b) Theoretical:

Military organization (Tables of Organization).

Service of Security (Field Service Regulations).

Personal hygiene (lectures).

Part V, Engineer Field Manual (including latest addendum); omit mining and demolitions.

2. MILITARY ART

(a) Practical:

Physical drill (Manual of Physical Training—Koehler).

Infantry drill (U. S. Infantry Drill Regulations), to include School of Battalion and Ceremonies.

First-aid instruction.

Range and gallery practice.

Practical military engineering—military mining and demolitions (Part V, Engineer Field Manual).

(b) Theoretical:

Lectures on general military policy as shown by military history of United States and military obligations of citizenship.

Service of Information (Field Service Regulations).

United States Infantry Drill Regulations, to include School of the Company.

Camp sanitation for small commands (lecture).

Part V, Engineer Field Manual—military mining and demolitions.

3. MILITARY ART

(a) Practical:

Same as course 2 (a) except practical military engineering, which will consist of knots and lashings and improvised military bridges.

(b) Theoretical:

United States Infantry Drill Regulations—School of the Battalion.

Small-Arms Firing Regulations, paragraphs 1-134.

Part II, Engineer Field Manual—Bridges.

4. MILITARY ART

(a) Practical:

Same as course 2 (a) except practical military engineering, which will consist of building military bridges, including floating bridges and instruction in rowing when practicable.

(b) Theoretical:

Lectures on recent military history.

Field Service Regulations—patrolling, advance and rear guard and outpost, orders and messages, marches and camps and camp expedients.

Ponton Manual.

5. MILITARY ART

(a) Practical:

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the students taking courses 1 (a) and 3 (a).

Military reconnaissance and sketching.

(b) Theoretical.

Review of Parts II and V, Engineer Field Manual.

Notes on Field Fortification (Army Field Engineer School).

Part I, Engineer Field Manual—Reconnaissance.

Company administration — general principles (papers and returns).

Two lectures on the History of Military Engineering (students to submit notes on lecture).

6. MILITARY ART

(a) Practical:

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the students taking courses 2 (a) and 4 (a).

Military reconnaissance and sketching.

(b) Theoretical.

Review of military mining and demolitions in Part V, Engineer Field Manual.

Review of Ponton Manual.

Field Service Regulations, paragraphs 354-410, 242-246, and Appendix 2.

Elements of international law.

Property accountability and methods of obtaining property (Army Regulations).

7. MILITARY ART

(a) Practical.

Duties consistent with rank as cadet officers, noncommissioned officers, and instructors in connection with the practical work and exercises of the students taking courses 1 (a) and 3 (a).

Military reconnaissance and sketching.

(b) Theoretical.

Field Service Regulations—Article V—Combat.

The use of engineer troops—Official Bulletin No. 4.

Map reading and map maneuvers.

Manual of Courts-Martial.

8. MILITARY ART

(a) Practical:

Same as course 7 (a).

(b) Theoretical:

Organization and equipment of engineer troops.

Night illumination of battle field.

Studies in minor tactics (School of the Line, 1915).

Lectures on military history and policy, based on Upton.

The schedule of training prescribes graded courses covering a period of four years, and instruction will be taken up as follows:

BASIC COURSE

Freshman year, courses 1 and 2.

Sophomore year, courses 3 and 4.

ADVANCED COURSE

Junior year, courses 5 and 6.

Senior year, courses 7 and 8.



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UNIVERSITY OF PITTSBURGH BULLETIN

Entered March 13, 1914, at the Post Office at Pittsburgh, Pa., as
second-class matter under Acts of Congress of August 24, 1912

The University of Pittsburgh Bulletin is published by the
University of Pittsburgh and is issued thirty times a year. It is
divided into series as follows:

ANNOUNCEMENT:—Including the General Catalog and
the Announcements of the College, Schools of Engi-
neering, Mines, Economics, Education, Chemistry,
Law, Medicine, Dentistry, Pharmacy, Summer Term,
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